



Freire's hope in radically changing times: a dialogue for curriculum integration from science education to face the climate crisis

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Abstract

This article advances a dialogue for understanding curriculum integration as a form of radical pedagogy, starting from science education in times of climate crisis. The paper weaves Paulo Freire's work about a radical form of emancipatory pedagogy, bell hooks's proposal to transgress boundaries in teaching, and the landscape of identities for science persons in order to embrace a radical pedagogy for facing the climate crisis: an anti-oppressive curriculum integration practice. The issue of climate change education is discussed in its challenges as we present some findings about the role of policy in incorporating climate change in education in Chile and the experience of a teacher, Nataly, coauthor in this work, integrating curriculum as an action-research project. We propose that an anti-oppressive curriculum integration emerges from converging two approaches: curriculum design intended for sustaining democratic societies and thematic investigations proposed for liberatory practices of the oppressed.

Keywords Curriculum integration · Climate crisis · Anti-oppressive curriculum integration · Climate change education

Resumen

Este artículo avanza en un diálogo para la comprensión de la integración curricular como una forma de pedagogía radical, iniciándola en la educación científica en tiempos de crisis climática. El trabajo entreteje los planteamientos de Paulo Freire para una forma radical de

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pedagogía emancipatoria, la propuesta de bell hooks de transgredir los límites en la enseñanza, y el panorama de identidades para personas de ciencia a fin de embarcarse en una pedagogía radical que enfrente la crisis climática: una práctica de integración curricular anti-opresiva. El tema de educación en cambio climático se discute en sus desafíos mientras presentamos algunos hallazgos respecto del rol de la política en la incorporación del cambio climático en la educación en Chile y la experiencia de Nataly, profesora y co-autora en este trabajo, integrando el currículum en un proyecto de investigación acción. Proponemos que una integración curricular anti-opresiva es el resultado de la convergencia de diseños curriculares hechos para la mantención de sociedades democráticas y las investigaciones temáticas propuestas para las prácticas liberadoras de las personas oprimidas.

In May 2019, Damian Carrington, environment editor of the British daily newspaper *The Guardian*, informed its readers about a new style guide for changing how they were referring to the environment, as well as the reasons for doing it. The editorial piece signaled that the term “climate crisis” would be preferred over “climate change,” in light of scientific discussions about climate change as a catastrophe for humankind. Similarly, “climate heating” would be preferred over “global warming,” among other changes. This change shows an increasing response to what scientists are trying to communicate regarding the abrupt changes in global climate conditions and their environmental and social consequences.

The Intergovernmental Panel on Climate Change (IPCC) was created by the United Nations Environment program in 1988, gathering thousands of scientists worldwide with the purpose of assessing climate change through reviews of up-to-date scientific knowledge. Its Sixth Assessment Report includes the latest physical understanding about the changes happening in the world’s climate, specifically that “Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened” (IPCC 2021, p. 10). This report provides strong support and evidence about the irreversible nature of humanity’s climate crisis, supporting Carrington’s (2019) editorial rationale for deciding to use the concept of “climate crisis.”

When the Sixth Assessment Report of the IPCC was released in August 2021, the world had been enduring the COVID-19 pandemic for about two years. According to a report from the Organisation for Economic Co-operation and Development (OECD) (Gouédard, P., B. Pont and R. Viennet 2020), at least 188 countries shut down their schools as an initial response to the pandemic in 2020, affecting over 1.6 billion students and their families worldwide. The provocative book *The Uninhabitable Earth: Life After Warming*, written by David Wallace-Wells (2019), explains the expected consequences of the climate crisis for humans and nature. But Wallace-Wells also devotes a chapter to the “plagues of warming,” emphasizing that changing conditions of climate could give rise to unknown consequences, as microorganisms and viruses react to these conditions.

During the COVID-19 pandemic, many countries adopted a form of remote emergency education, which made vast social and economic inequalities between and within countries visible. For OECD, one of the worrying consequences of the pandemic was the inadequacy of instructional resources for implementing emergency plans in education settings. Additionally, for many students, distance learning—or remote emergency education—became difficult, as the lack of conditions for schoolwork at home affected their concentration and reduced their time available for schoolwork.

As countries adopted educational policies in response to the pandemic, scholars around the world contested them, emphasizing descriptions and theorizations of injustice and systems of oppression. For example, Inny Accioly and Donaldo Macedo (2021) gathered educational thinkers from several countries in a book that addressed the idea of a “new normal,” or a refusal to returning to what had been denominated as “neoliberal normality”: a state of complex social and political issues that concerned educators around the world, before the coronavirus pandemic hit. No doubt, there was a worldwide state of crisis, which affected educators and communities. During the first months of the pandemic, Christina Siry’s (2020) editorial pondered: “What is the role of science education in a time of a global crisis? How can science education contribute new knowledge in finding ways forward that are equitable, and prioritize solutions focused on collaboration and social justice?” (p. 318).

Another wave of the COVID-19 pandemic is hitting the world as we close this writing. Educational systems have tried to adapt to the conditions of coexisting with the coronavirus and its variants, encouraging students to return to schools instead of going back to remote education. This adaptation might vary depending upon the conditions of each educational system. Massive vaccination has eased the impact of the pandemic for some countries, but—again—inequalities come to the fore, where less wealthy countries and societies do not have access to these medical technologies and continue suffering the worst consequences of the deadly virus. This pandemic became another challenge to the already critical environmental situation of the world. As we write this, it is likely that other pandemics are in the making, changing—like COVID-19 did—school experiences as we know them, and in ways that will be tied to how well prepared or not different countries are to face a new pandemic.

As educators, we have been engaged in questions not only for the science education community, but also for educators in general. We should reaffirm that our situated knowledge, including scientific knowledge, is and will be challenged as we face global problems such as the climate crisis and the current pandemic. As our position statement suggested, we are committed to inquire about the connection among education, peoples’ struggles, and the systems of oppression that precede both the current crises and the crises to come. Sara Tolbert and Jesse Bazzul (2017) described—and argued for—a turn toward the sociopolitical in science education, where discussions about science education shift from a traditional view of equity, access, and achievement toward making issues of marginalization, oppression, and political struggle more visible and important, and—in doing so—explicitly politicize science education. We are also committed to thinking of ways to understand these times critically, while observing educational responses from world leaders, local politicians, and our own local communities. We engage in questioning views and the experiences needed to face these radically changing times for science education. Also important to us are the places to investigate when thinking about reorganizing and preparing schools’ experiences and educational experiences in general for political action and social struggle in this time of crisis.

Building upon this commitment, we conceived of this paper by reflecting upon the contributions of progressive and emancipatory ideas for advancing an educational curricular response to the climate crisis. We argue in favor of an old concept and practical proposal: curriculum integration. We propose a framework for anti-oppressive curriculum integration, where the work of Freire dialogues with progressivist thought and intersectional feminist thought. This dialogue is current and future-oriented, and science educators are well-placed to participate in it. Science educators can help respond to the cries for showing the climate crisis to the world, but because of the complexity of the

issue, interdisciplinary perspectives, both within science and in dialogue with society, will need to be engaged.

We follow by presenting a brief review of anti-oppressive thought in education, highlighting the work of Freire in relation to environmental action and building a framework for an anti-oppressive view of curriculum integration. We continue by describing curriculum integration, mostly based on James Beane's (1997) account, as a way to complete the framework. Subsequently, we provide two examples for curriculum discussion: first, an account about how global policy discussion on climate change education has been conducted in Chile as a context for the development of anti-oppressive curriculum; and second, we provide the example of Nataly's work which addresses local environmental discussions based on curriculum integration. We view the experience of doing this integration as words of hope that dialogues with Freire's idea of education as the practice of freedom.

Anti-oppressive radical pedagogies in times of crisis

The magnitude of the climate crisis, the need to act upon it, and the lack of attention to it in classrooms show the need for radical and critical approaches among science educators. To develop such radical approaches, we rely on the work of Paulo Freire (1970/2000), whose contribution to naming and expressing a radical anti-oppressive pedagogy is highly regarded. Freire proposed principles and concepts to name and openly develop critical methodologies for educational experiences—e.g., curriculum—in situated contexts. We put them in dialogue with approaches for understanding experiences and critical stances aiming to transgress boundaries in teaching (hooks 1994). As science educators, we understand that this call will require us to think of ourselves not through disciplinary identities, but through an anti-oppressive identity that defines our roles in the climate crisis.

Freire's thematic investigations, hooks's transgressions, and Avraamidou's intersectional science identities

Freire's pedagogical-political project was an answer to the Brazilian historical present and past. According to Daniel Schugurensky (2011), Freire dedicated his doctoral dissertation *Education and Present-Day in Brazil* to this issue, dealing with silence and resistance in postcolonial Brazilian education. His dissertation was the basis for *Educación Como Práctica de Libertad* (Freire 1965). Freire understood that both Brazilian and Latin American societies were transitioning from being traditional to modern. To help such a process, a new way of thinking and doing education was needed. While that diagnosis may be different today, regarding the substance of that transition, the main concept continues to be quite intriguing when thinking about our current situation as a species. What education is required for societies that may face planetary agony? What education is required for a period when the intergenerational pact of inheriting a world where human life is possible for the next generation has been broken? Modern schooling seems unlikely to offer a feasible and credible way to address such a challenge. Freire's work, as part of the radical critique of modern education, may give some insights for a more participatory, dialogical, and holistic way to think and construct curriculum. In Freire's words,

For the anti-dialogical banking educator, the question of content simply concerns the program about which he will discourse to his students; and he answers his own ques-

tion, by organizing his own program. For the dialogical, problem-posing teacher-student, the program content of education is neither a gift nor an imposition—bits of information to be deposited in the students—but rather the organized, systematized, and developed “re-presentation” to individuals of the things about which they want to know more. (Freire 1970/2000, p. 93)

According to Freire, to understand a historical epoch is to understand the great themes of that moment, “the themes of that epoch” (Freire 1970/2000, p. 101). Those “historical themes are never isolated, independent, disconnected, or static; they are always interacting dialectically with their opposites. Nor can these themes be found anywhere except in the human-world relationship” (p. 101). This approach is both deployed in the process of constructing curriculum and the main form of curriculum construction. The focus on themes allows us to overcome those “alienating syllabi, compact programs that were ‘broken down’ and ‘codified into learning units’” (Freire 1973, p. 38) proper to traditional curriculum or discipline-based curriculum.

Therefore, the starting point for this radical view of curriculum construction must be knowing the present concrete situation in which people live. This requires a process of inquiry from where to develop the content of education.

The starting point for organizing the program content of education or political action must be the present, existential, concrete situation, reflecting the aspirations of the people. Utilizing certain basic contradictions, we must pose this existential, concrete, present situation to the people as a problem which challenges them and requires a response—not just at the intellectual level, but at the level of action. (Freire 1970/2000, pp. 95–96)

This process of inquiry is what Freire called “thematic investigation,” which looks to understand people’s “thematic universe,” and it is what “inaugurates the dialogue of education as the practice of freedom” (Freire 1970/2000, p. 96) in which, through dialogue, “generative themes” are to be found; themes “which men and women refer to reality, the levels at which they perceive that reality, and their view of the world” (pp. 96–97). Those themes are to be verified “not only through one’s own existential experience, but also through critical reflection on the human-world relationship and on the relationships between people implicit in the former” (p. 97).

The themes that Freire referred to show situations that limit people’s life. Currently, the threat to life itself at a planetary level, such as the climate crisis, is a situation that limits human life. For Freire, “the *themes* both contain and are contained in *limit-situations*; the *tasks* they imply require *limit-acts*” (p. 102, emphasis in original). Limit acts are “directed at negating and overcoming, rather than passively accepting, the ‘given’.” (p. 99)

When the themes are concealed by the limit-situations and thus are not clearly perceived, the corresponding tasks—people’s responses in the form of historical action—can be neither authentically nor critically fulfilled. In this situation, humans are unable to transcend the limit-situations to discover that beyond these situations—and in contradiction to them—lies an untested feasibility. (p. 102)

Consequently, Freire continues, “liberating actions upon an historical milieu must correspond not only to the generative themes but to the way in which these themes are perceived” (p. 102). For people, this requires them “to reflect on their own ‘situationality’ to the extent that they are challenged by it to act upon it. Human beings *are* because they *are in a situation*” (p. 108). As Freire states,

I must re-emphasize that the generative theme cannot be found in people, divorced from reality; nor yet in reality, divorced from people; much less in “no man’s land.” It can only be apprehended in the human-world relationship. To investigate the generative theme is to investigate people’s thinking about reality and people’s action upon reality, which is their praxis. For precisely this reason, the methodology proposed requires that the investigators and the people (who would normally be considered objects of that investigation) should act as co-investigators. (1970/2000, p. 106)

Thematic investigation, which curriculum integration is based upon, “will be most educational when it is most critical, and most critical when it avoids the narrow outlines of partial or ‘focalized’ views of reality, and sticks to the comprehension of total reality” (p. 108). Thus, the nature of this process is not only dialogical but also holistic, interconnected, and situated. This same nature is expressed in the curriculum’s architecture, which is “constituted and organized by the students’ view of the world, where their own generative themes are found” (p. 109). This thematic curriculum organization is a dialogical and integrated form of curriculum construction, developed in the language of pedagogy of liberation: an anti-oppressive curriculum integration conceived as a cultural action where organization of experiences addresses an understanding of oppressive forces in an integrated form. Decades ago, Maxine Greene (1974) affirmed that Freire’s proposal presents

new vantage points when I ask myself whether anything can be done in schools and what curriculum ought to signify in a world so dominated by bureaucracies and inhuman technological controls, when I considered the inequities and corruptions surrounding us today, and when I ponder ways of arousing students to choose themselves as persons who are committed, responsible, involved. (p. 69)

Despite its existential threat to humankind, we are under the impression that the educational dimension of the climate crisis has only been recently considered. Additionally, arguments about a crisis in education—particularly Western education—had been previously highlighted by educators and researchers. American feminist scholar and philosopher bell hooks (1994) explicitly stated a crisis of that sort, questioning the motivations for students to learn and teachers to teach; where educators are “compelled to confront the biases that have shaped teaching practices in our society and to create new ways of knowing, different strategies for the sharing of knowledge” (p. 12). In her argument, hooks urges progressive critical thinkers to regard teaching as a worthy place to act, in a way that carried Freire’s work. As she states,

The classroom remains the most radical space of possibility in the academy. For years it has been a place where education has been undermined by teachers and students alike who seek to use it as a platform for opportunistic concerns rather than as a place to learn. (...) I celebrate teaching that enables transgressions—a movement against and beyond boundaries. It is that movement which makes education the practice of freedom. (p. 12)

For hooks, teaching is performative in the sense that it creates opportunities for changing, for inventing, for adapting to the course of events, and highlighting the elements that make a classroom unique. Teaching is meant to engage people in active participation while learning, the educator included. bell hooks talked fondly about Freire’s assertion of *education as the practice of freedom* as it helped her to recognize that difficulties that minoritized students like herself went through during their schooling, such as experiencing a *banking system of education*, were an important critique of the system. She was confronted with the

idea of being a *subject in resistance*, and a person capable of defining her reality as such. Her call is an invitation to transgress through teaching, to

open our minds and hearts so that we can know beyond the boundaries of what is acceptable, so that we can think and rethink, so that we can create new visions, I celebrate teaching that enables transgressions—a movement against and beyond boundaries. (p. 12)

As we build an anti-oppressive framework for current times of climate crisis, we should understand that becoming an anti-oppressive climate change educator might require transgressions, which could also involve an identity shift, especially considering the regarded history of science in the lieu of education. Jay Lemke (2006), in a vision for researching for the future of science education, presented some of the issues that might link science education to a rather conservative and oppressive activity:

Current science education has become too isolated from all-age students' daily life issues and also from the moral and social wider preoccupations of older students (...) Government support to science education tends to reproduce artificial divisions that separate learning sciences from learning about humanities and the arts, and learning from society itself, including its history, laws, economy and politics (...) National pride and individual or elite interests have also pushed for making the dark side of human history and the dark side of science invisible, especially its long complicity with commercial, industrial and military inhumane projects (...) We should honestly face the fact that many students today, at least after primary school, have a negative attitude toward science and toward many of its technologies. (p. 9, free translation from Spanish)

Students and teachers alike, and therefore the general public, might hold views of science as an activity detached from social problems and issues of the time, together with a view of science as serving oppressive agendas. To propose an anti-oppressive radical pedagogy for science education seems a challenge in many respects, which includes challenging what science is and who can participate in it, or who can be a science person. Lucy Avraamidou (2020) engaged in the question of science identity, driving from sociocultural perspectives and feminist theory. In her work, she conceptualized science identity from an intersectionality lens, transforming it into a "landscape" where infinite possibilities for becoming a science person coexist. The use of the word "landscape" is intended to show the importance of place within a recognized science identity. Place is defined as "the social and cultural dynamics of a space or cultural geographies" (p. 325). When adopting this perspective, a science identity becomes dependent upon the complex matrix of the political, the social, the cultural, and the personal, all of which "are influenced by the demographics, the politics, and the overlapping of different power structures within a specific landscape" (p. 325).

Avraamidou's invitation to investigate science identity through an intersectional lens, and to consider that identity can be multiple, opens the field for science educators to engage in anti-oppressive radical pedagogies. This means also becoming a science person who can be an actively engaged sociopolitical agent, whose influence can provide room to include the social in both science teaching and scientific activity. This acknowledges the positioning of a science person within the complexities of places, cultures, social classes, gendered issues, religion, and race and ethnicity. This is very much aligned with the description made by Tolbert and Bazzul (2017) regarding the incorporation of the sociopolitical into science education. Science and science education can,

and should be, today, one of the places for addressing the main issues of our time from a multiplicity of perspectives.

In this line, Paulo Freire's *pedagogy of the oppressed* can provide powerful and hopeful tools for science educators to reflect and act upon the need for understanding and engaging in actions that confront contemporary crises stemming from climate change, such as the joint engagement in thematic investigations. bell hooks's recognition of backgrounds and call for transgressions opens questions that concern teaching and the boundaries that divide our activities as educators. Lucy Avraamidou's landscape offers science educators a vision of becoming, an avenue to explore what being a science person means in a time of climate crisis.

Taken together, these three contributions can form a framework to consider and hold in the development of an educational response to the climate crisis. As such, this framework provides a space for radical pedagogies, radical performances, and radical ways of organizing students' experiences. For us, a key issue in radical pedagogies is to have curricular tools that help us engage as communities in understanding the climate, its crisis, and the ways of acting upon it. Therefore, we talk about *anti-oppressive curriculum integration*.

Curriculum integration: school experience for life itself and individual and social problems

James Beane (1997) dedicated a book to curriculum integration, influenced by the ideas put forward by early twentieth-century progressive thinkers in the United States (e.g., John Dewey), but also as a reaction to the emergence of the term in times of conservative educational policies. For Beane,

curriculum integration is a curriculum design that is concerned with enhancing the possibilities for personal and social integration through the organization of curriculum around significant problems and issues, collaboratively identified by educators and young people, without regard for subject-area boundaries. (p. x–xi)

Beane was worried about both the confusion regarding the use of the term curriculum integration in the field and the disregard for the history of the term. From a critical perspective, he posited that curriculum integration involves four dimensions: integration of experiences, social integration, knowledge integration, and integration as a curriculum design. This view of curriculum integration is carefully distinguished from what he called "multi-disciplinary arrangements" which focus on how separate subjects are rearranged in a curriculum proposal without losing the features that distinguish them. This distinction is also presented with thematic arrangements, where children and youth's interests can provide grounds for organizing their school experience. If these interests are related to significant problems of the self and the social for children and youth, then there is closeness to engage in curriculum integration. But if these significant problems are only used for disregarding the separate lines among subjects, then, instead, there is a sort of closeness to a multidisciplinary or interdisciplinary approach.

Beane emphasized that curriculum integration is about centering curriculum in life itself, with a perspective on learning as continuous integration of knowledge and experiences, for deepening the understanding of ourselves and the world as subjects in it. An integrated curriculum should provide a space for serving young people as they live their lives rather than serving the interests of specialized knowledgeable adults. For Beane,

curriculum integration “brings the idea of democracy to life through its problem-centered focus, its uses of knowledge, and its participatory framing” (p. 18).

Curriculum integration, as a discussion, is not new, and has some manifestations in the history of the twentieth and twenty-first century, which Bean himself addressed in his book. Susan Drake and Joanne Reid (2020) discussed the emergence of “twenty-first century competencies” by reviewing the history of curriculum integration in the United States. They proposed four periods over 100 years where curriculum integration was part of the conversation. They called the first period “foundations of progressive education in the United States,” highlighting the work of John Dewey and his call for an inquiry-based curriculum, which should start from student questions rather than disciplinary knowledge. Moreover, part of the foundations for this progressive education movement was the conception that education should integrate society and have the purpose of cultivating a democratic society.

The second period was called “1933–1941 the eight-year study,” which refers to a study of about 30 schools in diverse contexts in the United States, aimed at creating relevant educational programs for non-college-bound youth by means of exploration and experimentation, and to understand the links between high school and college. Schools had some freedom to experiment, and some of them tried innovations such as organizing their curriculum by themes or issues relevant to students. This period of exploration and study yielded several results, most of which were positive for the argument in favor of curriculum experimentation.

The third period was named “1940s and 1950s core curriculum—the salad days” and featured some schools where the organization of school time blocks was used for programs that worked as non-separate subjects, with problem-centered programs less commonly present. These programs were more enthusiastically received in elementary and middle schools and less in high-schools, where subject-specialist teachers maintained their discipline-based curriculum. The imminent Cold War and the competition for technological and scientific development re-elevated core programs and a focus on separate disciplines for structuring curriculum. The fourth period was called “1980s and 1990s—the wild frontier” and saw a re-emergence of curriculum integration ideas, fueled by a concept-based curriculum approach, which in science, for example, can be illustrated by the movement for Big Ideas (e.g., Harlen 2010) to organize curriculum in an interdisciplinary fashion.

Beane's book on integrated curriculum was published in the latest period. In the words of Drake and Reid (2020), Beane had a reminiscent perspective of previous progressive eras. He

believed, like his progressive antecedents, that students should design their own curriculum with their teachers. Beane advocated that curriculum should start with students' answers to the questions: What questions and concerns do you have about yourself, and what questions and concerns do you have about your world? (p. 5)

This late period was faced with another more powerful and global movement: standardization of education. Paulina Contreras and Ivan Salinas (2015) have argued that standardization is an impertinent element in pedagogy; standardization being a political and global phenomenon where homogeneity is imposed into school experience at the expense of dialogue. Drake and Reid signal that standardization brought back attention to traditional school subjects because of the pressures for accountability through standardized testing. The era of standardization silenced the conversation about integrated curriculum. Drake and Reid have pointed out that, in addition to accountability, there is an international push for educational reforms that started at the beginning of the century, highlighting challenges

in learning, complexity, disruptions, and the advance of technologies. The silenced conversation for curriculum integration in the 1990s became again revitalized with terms such as inquiry-based, problem-based, and project-based learning, and reframed under what became known as twenty-first century skills/competencies. Drake and Reid mentioned three drivers for bringing back the discussion about curriculum integration in education: a reconceptualization of knowledge and the worth of what is to be known; the emergence and salience of “global wicked problems,” or problems that are ambiguous and not structured, without a possible solution; and the recurring issue of engagement of both students and teachers, resonating with bell hooks’s description of educational crisis in the early 1990s.

Solutions to wicked problems, if they exist, are “transdisciplinary. Students need experience in transdisciplinary problem-solving to be equipped to live with [the] ‘wickedness’ of the twenty-first century context (...) In overcrowded and fragmented curricula, [integrated curricula] can provide coherence and reduce duplication” (Drake and Reid p. 6). This account of the history of curriculum integration can be seen as an opportunity to bring back the fundamentals for its proposal in the first place (Beane 1997): the need to experience school as a democratic space.

However, we should be aware of interpretations of curriculum integration that portray educational innovations but do not question social, economic, racial, and gender structures that maintain oppression, and thus hinder democracy. For example, the push for STEM (science, technology, engineering, and mathematics) integration in the United States can be linked to economy-driven agendas that put forward the maintenance of economic competitiveness for U.S. industries, and in particular focused on preparing the workforce. In 2015, the signing of the Every Student Succeeds Act by then U.S. President Barack Obama brought STEM to light in a specific funding policy. In a critique of *A Framework for K-12 Science Education* and the Next Generation Science Standards, Kristin Gunckel and Sara Tolbert (2018) warned about the excessive technocratic perspective under which engineering is portrayed in the documents, making it a source of solutions to problems while ignoring social and political problems and issues of society. This agenda for STEM has also been explored in other contexts, where its connection to educators is not clear (Wong, Dillon, et al. 2016), and the agenda is shaped by ideologies of economic competitiveness, innovation, and production of capital (Takeuchi, Sengupta, et al. 2020).

Anti-oppressive curriculum integration as a challenge for science education in the climate crisis

A radical view on curriculum integration might make science teachers who cultivate specialized disciplinary knowledge concerned, as one interpretation of curriculum integration might be that school subjects can be directly questioned. In his book, Beane (1997) explains in depth the relationship and valuing of disciplinary knowledge, particularly signaling that institutionalized representations of disciplines as school subjects are not the disciplines themselves. Susan Drake and Joanne Reid (2020) stated important challenges for curriculum integration: a conceptual one—understanding the definition of curriculum integration and its practical issues; a political-framing one—using curriculum integration under a competency-based rationale; and an equity one—because it depends on experiential knowledge, there might be a risk of disfavoring students from low socioeconomic backgrounds when implementing some approaches to curriculum integration.

While these challenges are important, there are also other conditions to consider when thinking about teaching or educating about the climate crisis. A study in the United States indicated that current issues in schools dismiss attention to the climate crisis from the daily works of classrooms, even when the consequences of climate are felt and perceived in several areas of daily life worldwide (NPR 2019). This makes anti-oppressive curriculum integration a subversive way of organizing school experiences for students and communities around the world, as climate crisis consequences are being unequally experienced. It is also a call to action for organizing and making these issues visible for educators and communities alike.

Global climate crisis, challenges, and local educative response

As mentioned above, we are concerned with the climate crisis and an educational response to it. While this is a global issue, we will explain how it is expressed within the institutional framework that defines Chile's educational policy initiatives, which is part of our current effort to analyze climate change education curriculum policy and practices in Chile. We will offer high-level findings from the study of policy documents, but also provide an experience of curriculum integration in response to local environmental issues through an action-research project autonomously developed by Nataly, author in this paper and elementary school teacher. The following section includes a structural diagnosis of the state of awareness of climate change education and a creative link that can be promoted at the base of pedagogical action.

Climate policy in Chile and its educational dimension: our task ahead

Chile, a small country whose economy depends greatly upon the exploitation of natural resources, has been incorporated into the international climate change discussion and has signed agreements related to it. Some key international milestones that have oriented decisions about climate change education in Chile since the 1990s have been: the second Earth Summit in Rio de Janeiro in 1992, the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, the United Nations Convention to Combat Desertification, and the Kyoto Protocol. In the 2000s, the Paris Agreement was a key milestone toward reducing greenhouse gasses emissions.

These milestones and their agreements have oriented national decisions toward industry, and yet their links to schooling, higher education, and teacher education in Chile have rarely been explicit. As for educational programs, these international documents have focused on increasing professional capacities for specialized working and administrative staff, including strengthening research exchanges, as well as exchanges of educational materials. The agreements have also promoted awareness programs targeting the general public about conservation, sustainability, and climate change and its consequences. The programs work with nongovernmental organizations toward commitments such as article 12 in the 2015 Paris Agreement: "Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement" (p. 10). The United Nation's Convention to Combat Desertification includes an emphasis on the preparation of women and youth for the challenges of desertification. Thus, international agreements on topics related to climate

change had put education as one milieu of action, but not been about climate change education.

At Chile's local level, international agreements have been linked to specific legislative regulations and national guidelines, some of which have included educational features. As in international documents, current laws have emphasized the preparation of specialists and raising awareness of climate change or sustainable development among the public. Programs for this purpose had been assigned to the Ministry of Public Infrastructure and the Ministry of International Relations, and seldom led by the Ministry of Education. An exception to this includes the public universities legislation of 2018, which explicitly mentions the development of internal programs of instruction and awareness linked to environmental caring with a territorial focus.

Between 2003 and 2012, Chile's national guidelines expressed the need to complement and strengthen environmental education and sustainability programs in both formal and informal education. There were guidelines for schooling in all its levels and modalities—higher education, in-service teacher education, and civil society organizations, though absent were teacher educators and pre-service teachers. Within this period (2009–2013), two documents, a policy and action plan about sustainable development, were defined by the Ministry of the Environment (MMA 2009; MMA 2013), aiming to articulate existing national educational programs with environmental content, training the general public and raising awareness about current environmental concerns. The documents not only raised the need for a personal change, but also cultural and institutional transformations, introducing environmental certifications for schools and local governments. These changes verbalized the need for creating instructional programs and seminars for school principals, teachers, education assistants, school staff, and other professionals. Moreover, the documents emphasized the need for articulating and aligning instructional programs with current laws, linking environmental topics to national curriculum documents, and promoting intercultural educational programs that addressed sustainable development.

Other aspects of the documents voiced the need to provide instruction on how to develop management, pedagogical, and assessment practices that were coherent with commitments to environmental education or sustainable development. For example, instruct high school teachers, other formal educators, and informal educators, about water efficiency or provide them curriculum resources for water efficiency. Or promote programs for developing values, attitudes, and abilities for citizens altogether; programs about consumer rights and responsibilities, or about ways to address nature's risks. Two programs, articulated in international documents, specifically emphasize instruction for women and youth. However, as noted earlier, few of these programs were or are the responsibility of the Ministry of Education.

It was not until 2014 that documents with national guidelines began emphasizing specific programs for climate change. While these documents were mostly published by the Ministry of the Environment, they stated that both educational and awareness plans were elaborated by the Ministry of Education. The documents highlighted three formative areas. The first is related to generating national capacities and technical assistance, by focusing upon technological transfers for climate change mitigation and adaptation, climate change management, information production and monitoring, and fostering and supporting climate change research. The second is pertinent to informing and instructing citizens about climate change topics and highlighting—unlike previous years—links between climate change and local topics, while strengthening the local management of climate change.

The third formative area was linked to the climate change awareness and education of preschool, elementary, high school, and higher education students, which suggested the

inclusion of climate change adaptation and mitigation themes, making curriculum changes, and elaborating specific resources in formal education. For example, a new school subject was approved for upper high-school grades (11th and 12th): *science for citizenship*. The implementation of the new curriculum overlapped with changes in the school system due to the COVID-19 pandemic, and most teachers had to implement it in conditions of remote emergency education. This new curriculum was strongly informed by project-based learning, integration, and collaboration, and includes a unit about the environment and sustainability.

This period is noticeably different from the previous one, which was limited to using existing legislation or an existing curricular structure. In this period, there was a preoccupation with addressing climate change education themes as well as linking them to discussions about gender and the socio-educational conditions of students. These discussions can be linked to the IPCC report of 2014 (IPCC 2014), which conceptualizes climate change risks as the probability of evidencing, in a determined time and period, alterations of the normal functioning of a society or community because of physical events. For these alterations, there are three interconnected dimensions: threat, danger, and vulnerability. According to the 2018–2022 adaptation plan for cities (MMA 2018), a city's vulnerability increases with social factors such as poverty and marginalization, with women being more exposed to the adverse effects of climate change. Indicated by the documents, is the need to develop a connection between school management and community knowledge, and with nongovernmental organizations, fostered by collective reflection and participatory actions related to climate change. Furthermore, they promote a sustainability of actions (that is, sustained in time), as well as a need to incorporate an environmental education project within managerial instruments of schools (institutional educational projects or improvement plans). In higher education, the inclusion of undergraduate and graduate courses on climate change is encouraged, even signaling the need for creating climate change diploma courses and post-graduate and specialized technical programs, as well as elaborating informative and educational materials. But as was the case with the previous period, this period does not mention any emphasis on teacher education.

Given the scant consideration of teachers and students in international agreements, Chile's national legislation related to climate change, and the emphasis on instructing specialists, the discussion about climate change has been perceived to be mostly a government issue developed by government agents. For example, a study by Julio Hazbún, Paulina Aldunce, Gustavo Blanco, and Rodrigo Browne (2017) about the Chilean media portrayal of climate change concluded that, while individuals and civil organizations remain invisible, governmental actors are the primary definers of what is said about climate change. Together with preconceived ideas about science, the public might think that climate change is a faraway phenomenon. Moreover, since teacher educators and teachers may not be part of the target groups for the climate change education policy initiatives in Chile. Thus, it may be more challenging to address climate change through pedagogical discourse, let alone to have the space for thinking and teaching about the climate crisis, from a radical pedagogical perspective.

For the science education community, Ajay Sharma (2012) made a compelling case to start teaching about climate change through science education, but also expanding the case for curriculum integration:

The issue of global climate change cuts across disciplinary boundaries and covers all aspects of our lives and experiences. Thus, we may need to re-imagine education as a whole. However, science education would be the perfect place to begin as global

climate change connects so well with many core concepts in science, such as earth's biogeochemical cycles and ecosystem energetics. (p. 45)

In recent years an international movement requesting more decisive action from nation-states regarding climate has spread, featuring youth leaders that strongly make their points for climate action. In 2018, Swedish, then sixteen-year-old, Greta Thunberg gained attention as she launched a campaign for climate action, motivated by heat waves and the spread of wildfires in her home country. She inspired youth in several Western countries to go on weekly "school climate strikes" on a platform called "Fridays for the future" and became a prominent public speaker, urging politicians to take action to face the climate crisis. While Thunberg appears in a globally privileged setting, such as Europe, her message should be taken for what is likely to be a generational issue: the most extreme consequences of the climate crisis are being lived and will be lived by new generations, and, overall, by those with oppressed, rather than privileged, backgrounds. As a generational issue, the climate crisis requires understanding the main issue and its problems from multiple perspectives, mobilizing knowledge from different sources, organizing action in different milieus, and preparing for a rather extremely uncertain future both globally and locally.

Critical hope in praxis: a curricular integration from the bottom up

Devoting our work to an anti-oppressive curriculum integration for climate action is understandably challenging. Knowledgeable about these challenges, Nataly Bastías, coauthor in this paper, elementary teacher, and colleague from a southern town in Chile, decided to develop her master's thesis on an action-research project on curriculum integration (Bastías 2021). Her questions were linked to the perceptions of teachers, her colleagues, and herself, as they engaged in a curriculum integration project.

Nataly's views are coincidental with Freire's perspectives on the role of education, and her work is highly informed by the work of James Beane mentioned above. Her goal was to design a curriculum integration unit with voluntary colleagues in the upper elementary or middle school grades, aiming to understand what descriptions they made from their experiences and perceptions of their collaborative work. Nataly reports a highly critical view of Chile's national curriculum and its isolating effects on teaching. The description of her proposal reads:

Facing the current problem of having a system of school subjects that fragments knowledge and a pedagogical interest centered around curriculum coverage over learning, the curriculum integration approach results appropriate to inquire about its benefits in teaching-learning processes. This design seeks to foster pedagogical dialogue, through the collaborative work under which it is supported. In the same fashion, it is interested in posing themes of local interest, proposing that teachers, with the involvement of students, are those who define the topics for the development of classroom activities. (p. 30, free translation)

Nataly, herself an elementary school teacher who specialized in (Spanish) literacy, reading, social sciences, and history, was teaching arts education when she came together with the English as a foreign language teacher and the science teacher. Jointly, with their fifth and sixth-grade students, they developed an integrated curriculum unit focused on an environmental issue: the caring of wetlands in the local territory,

including the ones where the school is located. From the beginning, the three teachers gave importance to the study of the theme rather than to the specific disciplines they taught. The question they asked as teachers was “what can each discipline contribute to address the topic?” They planned lessons together not focusing on the school subject, but on the theme. Sub-themes that emerged were the following: definitions and characteristics of wetlands, risks and protection of wetlands, knowledge about wetland endemic wildlife (flora and fauna), and environmental conscience or awareness. The unit was titled “We need to talk about wetlands” and lasted seven weeks, meeting three times a week for 45 minutes in an online remote lesson. For planning and assessment, the three teachers met weekly for 40 to 90 minutes, spanning four weeks.

In the classroom, students explored the theme with the goal of producing a fanzine (see appendix) to inform their community about local wetlands. The teachers, while learning with the students, recognized the need for more specialized knowledge. They contacted a specialist from a local university to join a lesson as a guest speaker and share his knowledge about wetlands in the region. Also, they invited another guest speaker, an activist from a local women's group engaged in resisting environmental damage to the region.

Nataly's work and conclusions emphasize the beneficial nature of working collaboratively during the implementation of a curriculum integration unit, particularly for teachers. For her, “curriculum integration generated a space for pedagogical dialogue, where it was possible to plan, discuss, and share experiences aiming at bettering teaching practice and learning processes” (p. 78, free translation). Interestingly, the creation of dialogical spaces for curriculum integration is depicted as a critical form of subversion: “construction of dialogue and reflection are a central component of the teaching practice. This supposes a deep change in the current school structures, given that teaching work is situated in a more individual aspect, without much reflection and unconnected to the local reality of students” (p. 79, free translation).

Curriculum integration made it possible to deepen content knowledge, not only for students, but also for Nataly and her teacher colleagues. For them, having no knowledge of wetlands in the area made the curriculum integration experience a valuable one, as it allowed them to recognize environmental conflicts from a wider perspective, making content meaningful as well. This was also an opportunity to address an issue that is neither present in the official curriculum nor in the learning goals they needed to address. For the teachers, learning about wetlands was important because of the geographical context where the school is located, especially to learn about wetlands' care and protection. Moreover, Nataly explains that schools address climate change by using ideas that are not close to the students' experiences, or that they are repetitive (such as taking care of water or taking shorter showers, etc.). Curriculum integration could become a contribution for studying environmental topics, as well as facing the climate crisis from an educative perspective, transforming it into an urgent, meaningful, and relevant issue for students, teachers, and communities.

The work developed by Nataly, who decided to implement a curriculum integration over a thematic environmental issue, is a work of hope. Her work is dialoguing with Freire's ideas about practicing freedom when educating—by learning together, understanding the transgression provided by teaching a theme instead of a subject, and developing a new identity as a teacher, activist, and learner. Her commitment to understanding an issue alongside her colleagues and students is a contestation to current school curriculum structures. Integration not only concerns school content or disciplines, but also integration as working collaboratively with others. Her inclusion of the local issue of wetlands in the curriculum

for understanding its science, for developing actions together, while also considering its political implications, and while having students converse with local communities about wetlands, is highly connected to what it could mean to develop anti-oppressive curriculum integration initiatives. It is a transgressive act, which also highlights a collective endeavor.

Concluding comment

In this paper, we have developed an argument for considering curriculum integration (Beane 1997) as an approach compatible with anti-oppressive frameworks, such as the ones by Paulo Freire (1970/2000) and bell hooks (1994). In doing so, we proposed the idea of anti-oppressive curriculum integration, as a way of understanding and acting in a world stricken by an increasingly strong climate crisis. While discussing scientific literacy from a Freirean perspective, Dos Santos (2009) stated that science education does not account for sociopolitical views when addressing issues of science and technology relationships, science knowledge, and skills. A Freirean-humanistic science education perspective, as put by Dos Santos, will bring issues of global inequality for accessing scientific knowledge and technology, as well as issues of power over the use of technology. Therefore, a Freirean-humanistic science education should make oppressive relationships visible, so transformations can be seen as needed.

While we have not developed an extended account of the oppressive forces that are deployed inside the global climate crisis discussion, it is worth noting that the most oppressive forms of relationship that exist in the world today are also part of the relations that will establish the backdrop as the consequences of the climate crisis unfold. Continuous extreme climate events push peoples to migrate, and affect urban and road infrastructure, and means for life sustainment. The reasons for climate change's occurrence and its consequences are, not surprisingly, unequally distributed: some will have resources to face the consequences and others will struggle for survival. When Nataly decided to address the topic of wetlands with a curriculum integration unit, she opened the door not only to understanding the environment, but also to a whole conversation about sociopolitical issues, where water access and care is linked to issues of power over its use and property.

We contend that science educators who engage in forms of curriculum integration from a critical and anti-oppressive perspective can greatly contribute to increasing awareness about the climate crisis. This includes knowledge about it, but also, from an integrated emancipatory perspective, providing the necessary tools for future generations to engage in sociopolitical actions that confront injustices emerging as a result of adaptations to the crisis.

In this work, we have only presented the experience of curriculum integration of our colleague Nataly in a time of crisis. Other educators in other parts of the world are also struggling and sharing their experiences, such as the ones compiled by Bill Bigelow and Tim Swinehart (2015) in a work called *A People's Curriculum for the Earth*. We also think that science education can be a place to start, given the salience of scientific knowledge in understanding the climate crisis, but also because it will promote forms of challenging education that will be useful for the needs of the present and future generations.

An anti-oppressive curriculum integration framework for science education can move the conversation toward what Derek Hodson (2003) signaled as a time for action in science education. Furthermore, it can complement what Sharma (2012) urged science educators to look for: educate about climate change and action. Curriculum integration becomes a

tool that can also contribute to sustaining a curriculum policy discussion regarding contextualized climate science education, which could potentially reach more science educators, as well as educators in general, for addressing the climate crisis in collective action.

In this work, we have illuminated the case of Chile's curriculum for climate change, which—despite participation in international climate discussions for over 27 years—only recently has moved toward considering the topic within a new curriculum organization among the last levels of schooling. We believe that the curriculum integration approach can dialogue with current normative forms of curriculum organization, representing much-needed opportunities for teachers and students alike to “read the world” together, to confront the oppressive forces that play out in a world affected by the climate crisis and its inequalities. Anti-oppressive curriculum integration results from understanding and utilizing curriculum integration for sustaining democratic societies, and from the need for emancipation through education as a practice of freedom, embracing all the identity shifts this might imply.

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